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Climate Variability and Response Strategies Among
Communities in the Northern Parts of Kenya. A Critical
Literature Review

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CLIMATE VARIABILITY AND RESPONSE STRATEGIES AMONG COMMUNITIES IN THE NORTHERN PARTS OF KENYA. A CRITICAL LITERATURE REVIEW

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Abstract

Purpose: Although knowledge on climate variability is vital in addressing livelihood vulnerability to climate shocks, studies that link climate variability to rural livelihood responses and changes are few. The general objective of the study was to understand perception of climate variability and livelihood response strategies among the communities in the northern part of Kenya.

Methodology: The paper used a desk study review methodology where relevant empirical literature was reviewed to identify main themes and to extract knowledge gaps.

Findings: There is need for concerted efforts to build not only on adopted household adaptation strategies but also help them

reduce current vulnerability as well as build future resilience.

Unique Contribution to Theory and Practice: There is need to engage communities to understand their levels of vulnerability and design their own sustainable adaptation action plans. This can be done through adoption of the Community Managed Disaster Risk Reduction (CMDRR) model which among other measures involve capacity building of community members and development partners to participate in and help local people adapt to their livelihood strategies accordingly.

Keywords: *Climate change impacts, adaptation, livelihood adaptation strategies, climate variability, household*

1.0 INTRODUCTION

Scientific evidence increasingly suggests that climate is becoming more variable with significant impacts on small-scale farmers (IPCC, 2015). Of all the continents in the world, Africa particularly sub-Saharan Africa is the most vulnerable to climate change and variability. This is because majority of their rural population relies on rain-fed agriculture as a source of food production and livelihood foundation (Ayanlade, 2020). In Kenya, economic and livelihood systems depend on agriculture. Rural households in particular rely heavily on rain-fed agriculture thus changes in climatic conditions have far reaching implications on the households' social and economic wellbeing (Kung'u, 2015). In the past two decades, for instance, successive crop failure, water shortage and loss of livestock attributed to extreme weather events are increasingly blamed for deteriorating livelihoods among most rural areas in the country (Miyani, 2015).

Climate variability was projected to increase in Southern Africa countries including Kenya in the coming decades (Falchetta, 2019). Given that the process of climate change cannot be stopped quickly, it's crucial to understand in view of responses adopted by people whose livelihoods depend on it. Despite its multiple effects, awareness on climate change particularly among the rural folk in Kenya, however, remains low (Ageyo, 2020). An opinion poll carried out between 2007 and 2008; for instance, found that over 44% of Kenyans majority of whom are rural people depend on climate sensitive economic sectors have no knowledge of climate change or opportunities in it. A better understanding of farmers' perceptions along with adopted adaptation measures was paramount to inform future actions (Falchetta, 2019).

Although knowledge on climate variability is vital in addressing livelihood vulnerability to climate shocks, studies that link climate variability to rural livelihood responses and changes are few. However, researchers have emphasized the need to establish these link as well as its impacts as a key step in adapting to its effects (Maslach, 2016). Researchers have emphasized that climate change inflict harsh and extreme environmental conditions upon rural smallholder farmers and therefore reduces the livelihood options of poor farm households, especially within the agricultural and livestock sector. A study in Moyale and Marsabit, for instance, concluded climatic variability as a major risk in the region and recommended further research studies on long-term, site-specific effects as well as local perceptions of climate risk.

Moreover, there is increasing recognition that the traditional global study on climate change has little local and regional specificity thus often fail to address the regional and local impacts and the local abilities to adapt to climate change effects. Further, it was recognized that due to minimal standard definitions, absence or difficulty to get benchmark data, it's not easy to predict household climate change impacts and adaptation strategies at international level. Therefore, as strong imperative to understand the actual dynamics of climate change impact and adaptations at the lowest levels of the society, such as households, communities and districts were suggested.

Due to the risks arising from climate variability, communities especially those in semiarid environments whose livelihood are strongly impacted by the effects of climatic dynamics have

developed specific response to it over the years. However, studies have shown that some of those mechanisms increase their vulnerability to climate shocks instead of reducing them hence need for improved understanding (D'Amato, 2015).

1.2 Statement of the Problem

Northern Kenya is generally considered as a region vulnerable to effects of rainfall and temperature variability that are part of key climate parameters. Climate variability has characterized the region for decades on-end. Every year, local population witness's emergencies of new climatic patterns with more severe effects to their climate-based livelihoods than previous years. Besides, they spend invaluable efforts and resources to reduce its multiple effects which often manifest in form of biting hunger, livestock losses and acute water crisis in the area.

This area used to receive predictable rains that were well synchronized with planting seasons resulting to abundant yields from crop and livestock. This made the area a key food-basket within and beyond the district featuring always on top of district welfare ranking in the greater Northern Eastern districts. In recent years, however, the area has lost these glories. This was as a result of combined effects of persistent crop failure, livestock loss, acute water crisis and other social factors. Consequently, the division was infamous for heavy and continuous reliance on relief rations and a target for numerous emergency interventions from various stakeholders. Indeed, attempts to explain what might be happening are rife among the local population ranging from myths to spiritual dimensions of the perceived changes particularly to rainfall patterns. Premised on conviction that people must understand and internalize the changes prior to embracing and innovating strategies to live with, this study was conceived to assess people's perception on the variability and its perceived impacts on their livelihood. It aimed at answering the question; how local people do perceive these changes and its impacts on their livelihoods.

Prompted by unfolding climate uncertainty and its adverse effects on their nature-based livelihoods, local agro-pastoral households have been employing various response strategies to cushion themselves from the effects of the shocks. Increasingly, most households are changing their livelihood strategies with changing climatic hazards. Some of these response strategies could potentially form bedrock for adapting to current and future climate variability but remains largely unknown and in some cases ignored by development agencies and academia. Indeed, there are growing calls that poverty reduction should prioritize adaptation to climatic conditions based on existing local strategies hence need to understand these strategies (Leal Filho, W., 2019). This study identified these strategies at the households' level in communities in the Northern part of Kenya to adapt to the prevailing climatic condition. It also explored and provides menu of some emerging and desired livelihoods options which if well supported would enhance community resilience to future climate. Related shocks, enable local population to meet their needs as well as serve as a guide for livelihood interventions in the region.

1.3 Objectives of the Study

The general objective of the study was to understand perception of climate variability and livelihood response strategies among the communities in the northern part of Kenya.

1.4 Significance of the Study

This study will be beneficial to the local people on coming up with coping mechanisms and livelihood options as response strategies to climate change and variability. It will also benefit the government in developing policies and programs to enable the local community. The study gauged the perception of local people on climate variability and its impacts on their livelihoods. It not only enhanced understanding of how local people understand climate variability but also provided a basis for developing climate awareness and information at various levels. It also documented current livelihood response strategies which would serve as a foundation for designing and planning responses to effects of future climate change and contribute to conservation of key capitals. It provided key information to assess how livelihoods have changed over time and identified initiatives and practices upon which future adaptation would be based. Further, the desired response options identified would be a guide in integrating adaptation in local, national and regional development plans, program and policies for maintaining livelihoods among the agropastoral.

The study also explored livelihood support options in the area which would serve as a potential shopping list for government and development stakeholders engaged in fundraising for climate change adaptation program as well as in designing social protection and livelihood supports program.

2.0 LITERATURE REVIEW 2.1 Local perceptions and awareness

Despite varied impacts associated to climate change, the level of understanding and awareness on climate variation remains low and varied between regions. In United State (US), for example, climate changes are ranked low among the public as many people perceived it as spatially and temporally remote risk (Schroth, 2015). In Kenya, though El Nino phenomena of 1997/98 and increased frequency of weather extremes has raised national awareness of global climatic processes, awareness on climate variability remains varied among various groups.

While scientists explain it in terms of global warming phenomena, local people use indigenous knowledge, believes and environmental indicators to conceptualize it (Leonard, 2015). A study on climate awareness in Kenya indicate that although majority of people in rural areas acknowledge climate has changed, and continues to change, many are at loss when it comes to explaining the cause and effects of the problem.

However, researchers have noted that in order to embrace climate change as a new challenge and focus interventions on smallholders, knowledge on public perceptions and attitudes is of prime importance. Indeed, there is growing recognition that climate variability and people's Perception

is key in understanding climate-livelihood adaptation. (Nunn, 2018). This is mainly because the awareness of the effect of climate change on economic activities for which individuals depend on could make individuals more motivated to plan to adapt to any potential impact.

However, going by the number of available literatures on awareness, this seems to have elicited little interest from many researchers. A study done in Shinyanga rural district showed that the local communities were aware that climate has changed and blamed it for increasing household vulnerability to food insecurity, acute water problem and deteriorating livelihoods. It also found out that different socio-economic groups of households (the well-off, intermediate and poor) pursue multiple adaptation strategies which the researchers recommended for future adaptation planning. Such conclusion further emphasizes the need for undertaking location-specific studies to build a basis for future response options to growing climate risks.

2.2 Adaptation to climate variability

Communities living in the regions prone to rainfall variability have over the years developed mechanisms to adapt to its effects (Macchi, 2015) However, the speed of current climate change is feared to likely exceed the limits of adaptation in many parts of the world.

Therefore, adaptation has become a key focus among development and policy makers including the UN Framework Convention on Climate Change in recent years. (Bauer, 2015). This partially arise due to the observation that as variability in climatic elements increases, the vulnerability of rural livelihoods and the ability of smallholder households to deal with its shocks and stresses increases. As a result, most households are forced to innovative risk management responses to minimize the effects. These measures that occur at different scales (i.e., household, private sector, government institutions, and local, national) are sometime categorized as immediate coping strategies and long-term adaptation measures.

In most cases, the distinctions between the two are somewhat fuzzy. While coping strategies are involuntary and short-term actions by communities, households or individuals when faced with adverse impacts of climate change or natural hazards, adaptation may involve broader responses to stress, such as changing income sources, migration or other significant livelihood changes. However, while climate change and its effects have come to dominate the agendas at various levels, the sociologically informed literature on climate adaptation remains limited (Preston, 2015) Increasingly, it is realized that sustainable development and household food security of smallholder farmers in developing countries depends highly on their ability to cope with several risks affecting their livelihood. There is therefore a growing call for integrating farmer tactical strategies to manage climate risk to current development priorities. The question on knowledge of these strategies thus remains critical. This therefore makes any study on advancing such knowledge essential and relevant and timely. This is because in order to improve the ability of communities and households to effectively adjust to ongoing and future climate variability and change. There is need to enhance understanding on the risk they are facing.

Northern Kenya like most arid and semi-arid areas are prone to varied socio-economic challenges such as endemic poverty and restricted access to capital, making adaption more difficult (Chanza, 2018). In Saku district, large proportion of population relies on rain-fed agriculture which makes frequently experienced rainfall variability a real challenge to rural livelihoods and food security.

This has set off various adaptive responses among households with some rural households shifting from on-farm to environmentally destructive off-farm livelihood strategies.

Though involving both long-term and short-term options are commonly believed as a winning adaptation strategy, this study focus more on long-term adaptation responses as opposed to the short-term, reactive, and spontaneous coping options. Further, despite several adaptation options adopted by most households, the often-debilitating effects associated to climate change shows that these strategies are not sufficient.

Moreover, the link between climate variability and household livelihood response strategies remains largely unexamined. Nonetheless, consensus is growing that improving the ability of communities and households to adjust to effects of ongoing and future climate change impacts as well as developing long-term adaptation planning requires understanding of local practices (Singh, 2019). This is informed by growing believes that while climate change is a global phenomenon, adaptation is site-specific issues that require site specific knowledge and experience.

Furthermore, knowledge on responses identifies strategies with diverse characteristics for decision making purposes; i.e., those strategies whose impacts may increase exposure to other adverse effects, those that addresses multiple aspects of households' vulnerability or those which will remain useful regardless of the existing future climate uncertainties.

There is also an increasing recognition that past policy responses to climate change impacts and anticipatory interventions aimed at enhancing household resilience has been based on educated guesses. This is central because the process of climate change cannot quickly be stopped but we can find some adaptation strategies for community resilience against the climate change impacts. It makes it imperative to understand the livelihood options available to the poor and to sustain the livelihoods of those living in ecosystems.

2.3 Empirical review

Obwocha (2015), conducted an assessment of the impacts of climate change and variability on food security in West Pokot County, Kenya. There is an increasing need for food security assessment in the wake of today's challenge of climate change and variability. This study aimed at assessing the impacts climate change and variability on food security in West Pokot County for the period 1980-2012. Objectives of the study were to: characterize rainfall and temperature data for the specified years, evaluate spatial variability in relation to climate change and variability in the county using remote sensing and Geographic Information System (GIS), study the phenology of agricultural vegetation of the area and assess the perception of the household on the relationship between climate variability and food insecurity across three agro-ecological zones in West Pokot

County. Household survey, key informant interviews, analyzing rainfall and temperature data and GIS methodologies were adopted. Questionnaires were administered to 124 randomly selected households. LANDSAT and SPOT images were satellite images selected due to their high spatial resolution. The results of the study showed revealed high inter-annual rainfall variability. The mean rainfall was 973.4 mm p.a. for the years 1980-2011. Years 1984 and 2000 experienced the lowest precipitation of 631.6 mm and 619 mm respectively. Lowlands' temperatures have increased by 1.25°C and the highlands by 1.29°C respectively over the study period. Majority of respondents strongly believe (68%) that climate variability has occurred in the area with the lowland experiencing a great effect on crop production (75%) followed by the mid potential zone (27%) and finally the highlands (14%). Land cover land use changes showed that cropland has increased by 68% while grassland has reduced by 6%. The mean Normalized Differential Vegetation Index (NDVI) values ranged from 0.36-0.54. There has been a consistent increase in vegetation greenness in the three agroecological zones for the period 2000-2011.

Aga (2014), conducted a study on Boran Pastoral innovations in response to climate change; a case of Merti Division, Isiolo County, Kenya. Pastoralism is the main source of livelihood for Boran community inhabiting Northern Kenya. Over time, they have developed coping strategies aimed at unminimizing losses from aridity. Although the strategies may have served the community well in the past, they are presently perceived as inadequate in the light of climate change. This study investigated necessary adjustments in the strategies and innovations among the Boran in Merti Division of Isiolo County. The target population was 400 from which a random sample of 80 herders was drawn. All the 6 local chiefs and 6 community leaders in the area were also interviewed. Data was collected using semi structured questionnaires and key Informant interviews. The resulting data was coded and statistically analyzed using the statistical package for a social scientist (SPSS). Then the results were analyzed, discussed and presented in graphs, pie charts and tables. The results of the study showed that here were main drivers of innovations among Boran pastoralists in Merti Division. They include prolonged droughts, conflicts and invasive species which are linked to climatic changes. There were also response strategies which were found to be improvement in their usual drought coping strategies while others are newly emerging strategies. The innovation practices include agreement between herders and ranchers, livelihood diversification, inter-community negotiations, change in mobility, among others. The study established that 53% of the pastoralists were aged over 40 years while 47% were aged below 40 years though there was no significant difference between the two groups ($p=0.0921$). On the period the respondents had worked as pastoralist, the results showed that majority (52%) had worked for more than 9 years while the rest had worked for less than 9 years as pastoralists. Further, the results of the study established that climate change was a key driver of herders led innovation practices.

Ongoro (2010), conducted a study on climate change and pastoralist livelihoods shifts in Northern Kenya; the case of Samburu East in Kenya. The study was to examine the impacts of climate change on the livelihoods of the Samburu Pastoralists of Northern Kenya. The study further sought to identify and describe, the challenges facing the Samburu peoples' livelihoods initiatives in the face of climate change and finally to identify and explain how the Samburu cope and adapt to

climate change. Data for the study was obtained from primary sources. Primary data was collected using a structured questionnaire administered through face-to-face interviews with a sample of 180 household heads obtained through Random and purposive sampling. Focus Group discussions selected along the gender and age lines were also used. Key Informant Interviews were conducted with chiefs, traditional birth attendants, herbalists, community livestock attendants and circumcisers. Finally, life histories were constructed with two resourceful and elderly people. The results of the study showed that climate change is indeed a reality in the Samburu community. The respondents indicated that there has been gradual change in weather patterns over the past thirty years. The droughts were more frequent, prolonged and severe. The rainfall patterns too had changed dramatically. The findings indicated that the rainfall seasons were shorter, intense and erratic leading to floods that formed gullies due to sheet erosion. Temperatures had also changed with time. The community members further indicated that these changes had brought about some challenges that affected their livelihoods. The livestock lacked pasture and fodder during the dry periods and hence weakened and died, animal disease also caused death of livestock during the floods leading to socio - economic difficulties. The impacts of climate change were also contributing to high levels of insecurity in the community due to conflicts over resources such as water and pasture, as well as cattle raid after drought. The climate change induced droughts had dried up the natural sources of water leaving the community with acute water shortage. Women and girls were affected most because they had to trek long distances for water hence girls could not go to school and mothers could not engage in any useful activities. The Samburu as a people is trying to cope with the impacts of climate change by using indigenous knowledge to adapt.

2.4 Research Gaps

A knowledge gap occurs when desired research findings provide a different perspective on the issue discussed. For instance, Obwocha (2015), conducted an assessment of the impacts of climate change and variability on food security in West Pokot County, Kenya. Household survey, key informant interviews, analyzing rainfall and temperature data and GIS methodologies were adopted. Questionnaires were administered to 124 randomly selected households. LANDSAT and SPOT images were satellite images selected due to their high spatial resolution. The results of the study showed revealed high inter-annual rainfall variability. The mean rainfall was 973.4 mm p.a. for the years 1980-2011. Years 1984 and 2000 experienced the lowest precipitation of 631.6 mm and 619 mm respectively. Lowlands' temperatures have increased by 1.25°C and the highlands by 1.29°C respectively over the study period. Majority of respondents strongly believe (68%) that climate variability has occurred in the area with the lowland experiencing a great effect on crop production (75%) followed by the mid potential zone (27%) and finally the highlands (14%). On the other hand, our current study focuses on climate variability and response strategies among communities in the Northern part of Kenya.

Secondly, a methodological gap can be identified as the above researchers for example Ongoro (2010), conducted a study on climate change and pastoralist livelihoods shifts in Northern Kenya; the case of Samburu East in Kenya. Data for the study was obtained from primary sources. Primary data was collected using a structured questionnaire administered through face-to-face interviews

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3.0 METHODOLOGY

The study adopted a desktop literature review method (desk study). This involved an in-depth review of studies related to climate variability and response strategies among communities in the Northern parts of Kenya. Three sorting stages were implemented on the subject under study in order to determine the viability of the subject for research. This is the first stage that comprised the initial identification of all articles that were based on climate variability and response strategies among communities in the Northern parts of Kenya. The search was done generally by searching the articles in the article title, abstract, keywords. A second search involved fully available publications on the subject on climate variability and response strategies among communities in the Northern parts of Kenya. The third step involved the selection of fully accessible publications. Reduction of the literature to only fully accessible publications yielded specificity and allowed the researcher to focus on the articles that related to climate variability and response strategies among communities in the Northern parts of Kenya which was split into top key words. After an in- depth search into the top key words (Climate change impacts, adaptation, livelihood adaptation strategies, climate variability, household), the researcher arrived at 3 articles that were suitable for analysis. These results are findings from articles by:

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4.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS 4.1 Conclusion

The level of perception on climate variability and its impacts was high with repeated crop failure, reduced and/or loss of livestock holdings, increased households' poverty and rampant water shortage as the main impacts identified. The combined effects of climate unpredictability and lack of climate information at the local level was found to accelerate livelihood vulnerability to continued climatic shocks. There is therefore need for building information-based responses to climate change impacts.

Though most households have adjusted their crops farming and animal husbandry practices in response to climate variability effects, direct nature-based livelihoods (livestock tending and crop

cultivation) were reduced and alternative non-farm activities (casual and wage employment, sale of wood products and trade) increased.

While this study provides insights to what local population prefer in adapting to climate variability and indicate their strong intention to ameliorate adverse impacts of climate change, these strategies are both inadequate and ineffective in light of increasing effects of future variability. There is therefore need for concerted efforts to build not only on adopted household adaptation strategies but also help them reduce current vulnerability as well as build future resilience. The pursued livelihood enhancement measures should reflect people's preference both within and outside agropastoralist livelihood portfolio.

4.2 Recommendations

There is need to engage communities to understand their levels of vulnerability and design their own sustainable adaptation action plans. This can be done through adoption of the Community Managed Disaster Risk Reduction (CMDRR) model which among other measures involve capacity building of community members and development partners to participate in and help local people adapt to their livelihood strategies accordingly.

Invest in generating and providing demand- driven and client- oriented climate information to enable households to make informed decisions and potentially minimize economic effects of climate variability. This should be accompanied by disseminating the information in a form understandable to local users in addition to providing relevant extension services to households.

Initiate focused measures that would strengthen and rehabilitate current livelihood strategies and household assets to build future resilience. There is need for focused support from development partners and government to help in adaption initiatives. With remarks that assistance from some agencies is contributing to dependency, there is need to adopt a mix of climate adaptation and development approaches as well as focus o strengthening existing and diversified innovations at household level. This should also involve discouraging unsustainable and environmentally destructive income earning activities such as harvesting trees for firewood, timber and charcoal burning pursued by some poor households.

There is also need to address underlying causes of household vulnerability to climate variability and changes which poses key challenges to both current and desired livelihood strategies. Increase levels of literacy and overall improvement in infrastructure would help in building future adaptive capacities as well as enhance climate resilient livelihoods.

REFERENCES

- Ageyo, J., & Muchunku, I. G. (2020). Beyond the right of access: a critique of the legalist approach to dissemination of climate change information in Kenya. *Sustainability*, 12(6), 2530.
- Chanza, N. (2018). Limits to climate change adaptation in Zimbabwe: Insights, experiences and lessons. In *Limits to Climate Change Adaptation* (pp. 109-127). Springer, Cham.
- D'Amato, G., Holgate, S. T., Pawankar, R., Ledford, D. K., Cecchi, L., Al-Ahmad, M., ... & Annesi-Maesano, I. (2015). Meteorological conditions, climate change, new emerging factors, and asthma and related allergic disorders. A statement of the World Allergy Organization. *World Allergy Organization Journal*, 8(1), 1-52.
- Falchetta, G., Gernaat, D. E., Hunt, J., & Sterl, S. (2019). Hydropower dependency and climate change in sub-Saharan Africa: A nexus framework and evidence-based review. *Journal of Cleaner Production*, 231, 1399-1417.
- Leal Filho, W., Balogun, A. L., Olayide, O. E., Azeiteiro, U. M., Ayal, D. Y., Muñoz, P. D. C., ... & Li, C. (2019). Assessing the impacts of climate change in cities and their adaptive capacity: Towards transformative approaches to climate change adaptation and poverty reduction in urban areas in a set of developing countries. *Science of The Total Environment*, 692, 1175-1190.
- Macchi, M., Gurung, A. M., & Hoermann, B. (2015). Community perceptions and responses to climate variability and change in the Himalayas. *Climate and Development*, 7(5), 414-425.
- Mburu, B. K., Kung'u, J. B., & Muriuki, J. N. (2015). Climate change adaptation strategies by small-scale farmers in Yatta District, Kenya. *African Journal of Environmental Science and Technology*, 9(9), 712-722.
- Preston, B. L., Rickards, L., Fünfgeld, H., & Keenan, R. J. (2015). Toward reflexive climate adaptation research. *Current opinion in environmental sustainability*, 14, 127-135.
- Singh, P. K., Papageorgiou, K., Chudasama, H., & Papageorgiou, E. I. (2019). Evaluating the effectiveness of climate change adaptations in the world's largest mangrove ecosystem. *Sustainability*, 11(23), 6655.